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Science Service Conference:
Remarks by Dr. J. McKeen Cattell; Dr. Simon Flexner; Dr. Karl T. Compton; Dr. Frank B. Jewett; A. H. Kirchhofer; Dr. John C. Merriam; Dr. Arthur A. Noyes; Robert P. Scripps; Dr. Edwin Bidwell Wilson; Dr. C. G. Abbot; Dr. W. F. G. Swann 151

The New Harvard Biological Laboratories: PROFESSOR G. H. PARKER 158

Obituary:
Irwin Gillespie Priest: DR. LYMAN J. BRIGGS 162

Scientific Events:
The British Union of Chemical Societies; Dairy Science Publication; The Placement Bureau of the Federation of Biological Societies; Appropriations for Grants-in-Aid by the National Research Council 162

Scientific Notes and News 165

Discussion:
Note on Premature Flowering in Grapefruit from X-rayed Seeds: C. N. MOORE and C. P. HASKINS. *Necrobiotic Rays:* PROFESSOR W. W. LEPESCHKIN. *Probability of a Magnetic Storm during the Solar Eclipse of August 31:* A. M. SKELLETT. *A Proposed Working Abstract of the Literature of Chemistry:* DR. J. N. SWAN 167

Scientific Apparatus and Laboratory Methods:
A Pipette for the Dilution Counting of Hookworm Eggs: DR. J. ALLEN SCOTT. *Mercury Vapor Pumps for Vacuum Distillations:* RALPH H. MUNCH 170

Special Articles:
The Validity of Measuring Eye Movements by Direct Observation: FRANCIS P. ROBINSON and PAUL G. MURPHY 171

Science News 6

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SCIENCE SERVICE CONFERENCE[1]

By Dr. J. McKEEN CATTELL

PRESIDENT OF SCIENCE SERVICE

SCIENCE SERVICE, organized eleven years ago, is making a new departure to-day and has brought together in this conference some of the ablest scientific men of the country. As we all know, Science Service was made possible through a gift of the income from $500,000 by the late E. W. Scripps, one of the most original and fertile men with whom I have ever been personally brought in contact. But we are also under obligation to Dr. Ritter, on whose assistance Mr. Scripps relied in establishing the service. If Scripps was the Charlemagne who could do all these things with high hand, Ritter was the Alcuin who advised him. The indebtedness of Science Service in its organization is also great to the group of scientific men in California to whom science owes so much —Dr. Hale, Dr. Millikan, Dr. Noyes, Dr. MacDougal, Dr. Merriam and Dr. Kellogg. Finally, tribute should be paid to our first director, Dr. Slosson, a man of remarkable literary skill with scientific training and a high standard of accuracy.

We have gone on for eleven years with some successes and some failures. My own attitude has been to criticize Science Service severely to the other trustees and officers, to defend it and even on occasion to eulogize it to others. There are here those who will offer criticisms, but we should like also to know in what ways the service has been of use. We want this conference to be strictly informal. It was our original idea to have a round-table in the library, but we found greater interest than was anticipated and had to come into the lecture room. Now we want short and informal remarks from those who are willing to give us advice and help.

By Dr. SIMON FLEXNER

DIRECTOR OF THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

IN response to your request, I am very happy to express my views regarding the manner in which

[1] Report of remarks made at the Round-table Conference held by Science Service in Washington, on April 27, 1932.

Science Service presents medical news or discoveries. But before attempting to do so, I should like to state that I read the weekly reports of the Service as given in SCIENCE with interest and profit.

Medicine, as you are aware, embraces not a single subject or science, but rather a group of subjects or sciences. No one person can judge or speak adequately for the whole. In essence, I desire to make two recommendations:

First, greater discrimination of what constitutes a discovery or a valuable news item. It happens not infrequently that a "discovery" is announced, the knowledge of which is by no means new; and it also happens that a piece of medical news is stressed, when in fact it has no great interest or importance.

Second, especially in regard to so-called medical discoveries or news, I should advise against overstatement of meaning in terms of practical significance and application. This, in my opinion, is a highly important consideration. The lay public should not be misled into false hopes by exaggerated statement.

Since medicine includes many sciences and no one person can have fair judgment about them all, I should like to ask whether some connection could not be made with a younger person on the staff of the Johns Hopkins Hospital Medical School, which is near-by, to act on Science Service in an advisory capacity. If the right person were chosen and a suitable consideration arranged, he himself would probably be in a position to give informed advice or secure it from his colleagues. Not much time need be consumed in the process. And the result would surely be a more discriminating service.

By Dr. KARL T. COMPTON

PRESIDENT OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

I WISH to preface my remarks perhaps with a personal touch. My young daughter is in no sense a scientist, but I have been very much delighted at the fact that the first thing for which she asks when she comes to our magazine rack is the *Science News Letter*. I have mentioned that to various of my friends and I have found that it is not an uncommon occurrence. I think it is certainly true that the *Science News Letter* is read with interest, and I think that it is one of the functions of the Science Service which is well deserving of support and well deserving of extension.

Along the line of Dr. Flexner's remarks I will say it is certainly true that things do appear from time to time which rather disturb people who are experts in the particular field with which the articles referred to are concerned, and it seems to me that Dr. Flexner's suggestion is an excellent one. There should be something like an association of consulting experts who can be reached easily and who should be consulted on things that involve such questions as priority and apparently really important discoveries. It is not very satisfactory, for example, to have announced as an important new discovery something which you happen to know has been known and worked on adequately for a number of years. That occurs once in a while. I think it is not a severe criticism of Science Service, but it seems to me that it is one minor difficulty which can be remedied by some such procedure as that suggested. I think that the efficiency of this kind of work might be increased by perhaps soliciting more cooperation among various science groups and of fitting into Science Service the things which will be of interest.

Dr. Cattell has impressed upon me from time to time that, as a representative of physical science on the executive committee of the Academy of Sciences, it is my duty to see that physical papers are submitted from time to time to SCIENCE. I think in some way all of us who are interested in the development of public interest in science have an obligation to see to it that our organ for informing the public is used to the best advantage.

After all, it is certain that we are all enabled to carry on our work, in the last analysis, because of public interest, and we can not afford for any reason to overlook the necessity of obtaining public interest. I think it is a duty we have—sometimes a duty which to an individual may be unpleasant because of his retiring disposition—it is his duty to keep the public interested and informed of what is going on.

As to the various lines of work which Science Service does, there is one that disturbs me, and this is the function of Science Service as a news agency for the papers, which, in a considerable sense, is in competition with the Associated Press and the other press services. I am not well enough acquainted with the original idea to know whether that is an essential activity of Science Service or not. I think it is largely as a result of the work of Science Service—at least Science Service has largely contributed to it—that the public has become very much more interested in scientific news and that the newspapers are eager to get scientific news. These papers and the Associated Press now have some excellent science editors who are very anxious to get scientific news. The doubt in my mind is whether or not it is wise to maintain a competing agency. Science Service, as I see it, is not an end in itself; it is a means to an end. I would like to raise the question as to whether or not this particular end might be achieved more effectively, not by maintaining a competing service, but by maintain-

ing this service as a cooperating agency to cooperate essentially with the Associated Press and the other press agencies, covering perhaps those scientific subjects which the Associated and other press services are not covering and treating the material itself, rather than distributing it as an independent organization. I am not at all sure but that we would get more effective scientific publicity of the right type by making this essentially a cooperating rather than a competing agency. Even if this is done, there are a great many things which Science Service can do. It is a unique service because of its connection with the Academy and the American Association for the Advancement of Science. This association is a unique approach to scientific people, and I think that it opens avenues of service which no other organization can possibly have.

By Dr. FRANK B. JEWETT

PRESIDENT OF THE BELL TELEPHONE LABORATORIES

I DOUBT if the few remarks I am going to make will be very instructive or will necessarily commend themselves to the approval of this group. However, they may be provocative of thought and discussion which may in the end be helpful to an enlarged and more effective Science Service.

I am not particularly interested in the further development of Science Service simply to amplify it as a means of adding to the stream of interesting scientific information, particularly with regard to new things. Including the present Science Service, we have plenty of agencies doing that job already. No doubt there is a great interest in that sort of thing, and because we are all curious about such matters that interest will continue and in some way continue to be satisfied.

The thing that I am most interested in and the thing I think Science Service may be peculiarly in a position to further, because of its connection with the National Academy and the National Research Council, is so to amplify or modify its present machinery as to give those who use its service, whether they be newspapers, magazines or individuals, a better understanding of the part which science and new knowledge in science can and must play in our every-day lives. We are living in a mechanized age, and yet we have been and are trying to operate these new things of science under the rules developed for an entirely different period. Further, these rules are made, not by scientific people but by people whose primary interests in life are essentially not scientific and who with the best of intentions know little of science. For this reason it seems to me highly important that, just so far as it is possible, we who do know something of science ought to see to it that information concerning the fundamentals of science and of how it may affect the daily operation of our lives is both fully, accurately and widely disseminated. In no other way can we expect the great mass of human beings properly to understand that which is fundamental to their well-being or to act sanely on the basis of that understanding.

It is a hard and difficult problem, but until we do sense the thing and get a better understanding of the ways in which science and the things of science are entering into our lives, just so long, it seems to me, are we going to be confronted with all kinds of legislation which seeks to control by fiat things which, in the last analysis, can not be controlled by mere human desires. It does seem to me that because of its past and present achievements and its unique relationship to the fountain heads of accurate scientific knowledge possibly Science Service, while still carrying on whatever may be best of its present activities, can perform the service I have outlined and thus give to the country, through whatever media are most suitable as outlets, that helpful guidance it so much needs. I know of no other agency so strategically situated.

By A. H. KIRCHHOFER

MANAGING EDITOR OF THE BUFFALO EVENING NEWS

I SHALL speak strictly from the standpoint of the newspaper man, and do so frankly because without candor there can be no common approach to the problem for which we seek a solution.

The first thing we must recognize is that, in spite of the progress which has been made in more accurate reporting of scientific, educational and allied activities, there are many in these fields who give little or no credit to the newspapers for what has been accomplished, and by their critical attitude toward newspapers as a whole, without being specific in their objections, make for misunderstanding rather than the cooperation which is essential to a still more accurate and sympathetic reflection of the view-points of the specialists.

It is equally true that, under the sting of some of this lament and criticism, there are newspaper men who demonstrate their impatience by an aloof attitude, so that the net result is to create an atmosphere in which it is impossible to carry on constructive work. We must have tolerance, patience and understanding on each side. I am certain that you will find newspaper men ready to respond to any reasonable overtures. I think there is work to be done in both fields to bring about a clearer understanding of our respective view-points and aspirations, as well as limitations.

Many, if not most, newspaper men are socially minded; they sympathize keenly with the scientist

who wants his work and that of his associates intelligently interpreted to the public, but in making that possible the scientific group must come out of their shells; they must take a human as well as a scientific view-point; they should have some insight into the newspaper outlook and at least give the newspaper man credit, until he proves otherwise, for knowing something about his own job.

The scientist frequently would appear just as ridiculous if he attempted either to write a newspaper story or operate a paper as the newspaper man often appears to him, when he attempts to explain for the benefit of the lay reader some of the things which even scientists occasionally do not understand or about which they disagree. Nevertheless, I observe that some scientists think they know all about newspaper work as well as their own. My experience has indicated that the man who is willing to take time and patience to explain a story to a reporter, who is not a specialist in the same field, usually fares very well in having it reported as he would like to have it presented to the public.

Too often the scientific man thinks wholly in terms unrelated to those in which he is approached by a reporter who wants a story about the matter in hand. The problem is to reconcile divergent view-points; to force both from a high-horse attitude; to bring about mutual respect. Surely, the scientist knows his subject better than the reporter. On the other hand, the reporter knows the limitations of time and space under which he must work, and should have a clearer idea of how to explain what he has learned to the public.

Real progress has been made in all forms of reporting and interpretation of news, and especially in reporting scientific news. Newspaper standards are becoming more strict, and even now there are large numbers of papers outside the metropolitan areas which have on their staffs men whose duty it is to specialize in reporting various forms of news. On the smaller papers obviously it is not possible to specialize to such an extent, but many unknown but among the best reporters in the country report for such papers.

The fact that these advances have been made; the fact that this conference is held; the fact that many other efforts are under way, some of them in newspaper circles, to bring about more effective reporting is the surest indication that we shall continue to make substantial progress in accurate reporting.

I know it will come about more quickly if all those who feel that their special fields are not interpreted to the public with the precision they believe should exist will join with the newspaper workers to envisage this as a problem to be approached from a mutual standpoint rather than from the unfair view that the specialist is always right and the newspaper always wrong. And some of this feeling is due, we must remember, to the fact that newspapers can not and will not surrender to any group the right to say what shall or what shall not be printed.

This brings me to Science Service, which since its organization has been the most pronounced factor in the country for promulgating accurate scientific information, in terms understandable to the layman and average newspaper reader. It has made it necessary for other news services to engage qualified experts to handle scientific news, and it has set a standard of interpretation and evaluation that makes it an almost indispensable adjunct to the newspapers which publish its articles.

This has been accomplished, I think, because Science Service has been able to speak authoritatively in terms comprehensible to all. It has been accomplished because Science Service, without in any degree sacrificing what every scientist stands for, has had the newspaper view-point. It has met the newspaper needs, both in writing and distribution. It has not done what is a bane to newspaper offices, to wit, become a press agent for any one or any thing. It has avoided all suspicion of propaganda. It has maintained a fine sense of balance in relation to scientific news.

Here, then, is an example of a scientific news service performing genuinely worth-while work for the newspapers, their readers and for both the worker in science and the scientific idea. Science Service must constantly, as must all newspaper and press associations, keep abreast of the swiftly moving march of progress. It should, in my opinion, continue to interpret scientific developments in newspaper terms along rational lines. It should contribute to the understanding of the editor quite as much as to the education of the reader, so that the former may know more clearly what of authentic scientific news to print as well as what of pseudo scientific news to discard.

Please keep in mind that in the work Science Service has been doing it has performed an excellent job of reporting factual material, as developed in the laboratory or under laboratory methods. It would be easy for one, who has the wish to see more intelligent exposition of the social sciences and their great influence upon our lives and affairs, glibly to say that Science Service should enter this field in the hope that it can interpret it as well as it has explained the exact sciences. Such a venture should not be embarked upon without a full and clear realization of the difficulties it would encounter.

First and foremost, in attempting to interpret the

social sciences, particularly history, economics, psychology and sociology, you must avoid any and all semblance of what some might call propaganda for either an idea or a cause. To do so will not be so easy as it is to avoid that in discussing exact science. The subjects frequently are controversial; too often inter-connected with political theories. Such matters can be handled as news, but you have to be careful in doing it for the reason, frankly, that you come into conflict with some accepted ideas. These accepted ideas may be right or wrong; I am not attempting to say; I am pointing out a state of facts.

If you decide to interpret the social sciences, you absolutely must avoid any justification for the view that propaganda is being presented. If you don't, you will endanger the reputation Science Service now merits and enjoys. Such an extension of your service also must be considered in relation to the views of newspaper editors on various matters of policy. They all are willing to publish news; they all are skeptical of publicity.

In closing, may I offer a word of caution about expanding a service to newspapers which at the moment isn't essential, even if offered at merely nominal cost.

By Dr. JOHN C. MERRIAM

PRESIDENT OF THE CARNEGIE INSTITUTION OF WASHINGTON

THESE few minutes I wish to devote to what might be called the art of stating scientific truth. This is in considerable measure the function of Science Service. The limit has not yet been reached in development of scientific literature. I recognize literature as perhaps the greatest of all arts, the most human and also the most picturesque.

Nearly everything that comes within the range of science has existed for a long time. I am not sure that mere discovery makes anything more important than other things. I have known cases in which reporters mistakenly brought out old things as if entirely new, and with great success. It depends upon the form of statement and the human interest.

I wish to suggest, but not for Science Service alone, that there is a zone of difficulty and of danger precisely at the point where the press would like to secure new material. I presided yesterday in a meeting where four men presented extremely important statements on the results of scientific research. Among these papers there was considerable difference of opinion. That was the reason for the conference. It was because men see problems from different points of view. When the investigator begins his task he is trying to advance a fraction of an inch further than any one else has gone. A stage is passed through in nearly every investigation where the result is not clear and therefore can not be stated clearly and simply. If this were possible, it would not be necessary for the investigator to concentrate on this problem.

The fact that the press desires to have new material is extremely important in development of scientific research because it stimulates the investigator to attempt a clear statement of the thing he is trying to do. Not infrequently the fact that the public desires to know what the man is attempting acts as a stimulus to the investigator and helps to clarify his thought. It helps the researcher himself to secure a clearer idea of what is attempted. Beyond this there is a further stage at which the problem is seen clearly. It is then necessary to formulate it in terms which represent application of the art of stating scientific truth.

The best form in literature is based first upon accurate statement, second upon logic and third upon artistic presentation. If a fact is to be stated clearly, it must stand in striking contrast to its background and yet be related to that background. It is essential also that the element of human interest be included in the picture.

There is an art in use of thought and language in presentation of scientific truths. This art may well challenge the interest of any scientific man. There is always opportunity for improvement. I congratulate Science Service on its success to date.

By Dr. ARTHUR A. NOYES

DIRECTOR OF THE GATES CHEMICAL LABORATORY, CALIFORNIA INSTITUTE OF TECHNOLOGY

I HAVE only two points of view to present. We all realize that the information that Science Service gives to the public must be reliable, but something more than that is necessary. The great defect in the scientific information that is disseminated through newspapers is that there is nothing to show whether it is accurate or not. In three cases out of four it is not reliable and is therefore misleading. It seems to me very important that an agency like Science Service be careful to make clear, so far as it is possible, the evidential status of the information that is submitted. Where there is uncertainty as to the results, the evidence should be brought before the public. For, as I have said, one of the greatest defects of popular scientific publication is that one does not know whether it means anything whatever.

The other point I would make is one of procedure. This I hesitate to suggest, because I realize that Science Service has used almost every available means. But I believe that at the different universities which are centers of research, there could be secured at relatively small expense able science students with

literary skill to collect news of scientific advances and turn it into the central office. This would make reliable statements more quickly available and would amplify the material from which Science Service could prepare its digest of scientific news.

By ROBERT P. SCRIPPS

THE SCRIPPS-HOWARD NEWSPAPERS

I WAS an instigator of this general meeting. But it was not my feeling, then, that any large part of the program should be speeches by myself and fellow Science Service trustees. We have been talking together about our problems for a number of years, and of course have made some progress. But what we seek is a larger and an accelerated progress. As I see it, the purpose of this meeting, and of that to-night, is to receive criticism and suggestions on the functioning of Science Service from outside sources—from men interested, as we are, in the state of civilization in America, who are not identified with our organization, and who are in a special position to help us just because they can bring to our meetings a fresh, detached view.

I also took part in the first discussions of the project which has developed into what you see to-day—Science Service, a going concern, dedicated to the proposition that, for the masses as well as for the classes, knowledge is power; but dedicated also to the further proposition that knowledge must be considerably more than half-baked to merit that description. As a member of those early conferences, I think I may be allowed one historical reference.

And that is that the name first thought of for this organization was not "Science Service" at all, but "American Association for the Dissemination of Science." In spite of its length and possible suggestion of the ponderous, I have always thought it a more truly descriptive title than the present one.

Anyway, its logic was sound. For the promotion of study and research in the exact sciences, this country was already supplied with the three great organized bodies by whom the majority of our board of trustees are nominated. But in spite of the real interest of a democracy as such in these achievements, so far as the layman, the voter, the real arbiter of American destinies, was concerned, these great agencies functioned each within its ivory tower.

The need, it was felt, was for a new agency, especially organized and equipped to tell the millions outside the laboratories and lecture halls what was going on inside.

The purpose was to make possible application of the facts and methods of science to the affairs of common social and political life—from such elementary aspects of this life as public education and hygiene, to the psychological problems involved i legal procedure, or the economic ones of a tariff bi

It is all very well to say scientific research will g on, whether any one outside the laboratories kno about it or not; or that the scientist can not take t much time off to consider the end result—the effect o humanity—of his labors. I challenge both position

In the first place, the direct influence of the mult tude can not be underestimated. It is the man in th street, whom you have not reached, who is ultimate responsible for incidents like the Dayton, Tennesse trial, and state laws which make such trials possibl It is the man in the street, and his attitude, that also ultimately responsible for appropriations to gre state and national institutions, where much of th world's scientific work is carried on.

As to the disinterest of the scientist himself i humanitarian effects, I have known intimately t many fine, sympathetic gentlemen who were gre scientists to believe it even exists.

It is, perhaps, largely influenced by the idea o further challenging the interest of the multitude tha some of us feel there should be greater cooperatio between Science Service, an organization deliberatel planned for domination by workers in the so-calle exact sciences, and already existing organizations i the so-called humanistic sciences and professions— economics, sociology, medicine, the law, etc. I for on feel that any reasonable means of increasing thi popular interest merits most serious consideration Certainly, the economic field alone is one where chao exists to-day, on a most unscientific basis, and when light from scientists—I think from Science Service— may well be looked for.

Gentlemen, one great problem of our day is t make the millions feel, before they perhaps lose thei patience, that all our facts and all our scientific theories *can* be made to have bearing upon such vita matters as war, poverty, insecurity, unemployment disease—even political misrepresentation.

It is my feeling that the question now before us i simply that of the fuller and freer functioning an leadership of Science Service in this cause. It i for their aid on this point, particularly, that we wil have to thank our guests on this occasion.

By Dr. EDWIN BIDWELL WILSON

PROFESSOR OF VITAL STATISTICS AT THE HARVARD UNIVERSITY SCHOOL OF PUBLIC HEALTH

MOST of the complaints that I have heard about Science Service are in respect to its accuracy. I say we might do well to consider accuracy as a relative term. I have seen a great many bright young Ph.D.s destroy their instruction to freshmen by trying to guard themselves with all the qualifications that they

knew, some of which were not very well established, with respect to every statement they made. I don't call that accuracy. That is precision, but it is not accuracy. When you are talking about accuracy in newspaper work, it seems to me the criterion must be whether or not you get across to the person who reads it the thing it is important for him to get out of the item and not the thing important from the view-point of the man who does original research. I have not found Science Service particularly inaccurate. I have not found the newspaper work particularly inaccurate.

When I was last in Toronto as president of the Science Research Council, a couple of young men turned up to interview me, and the next morning my friends tried to "josh" me about the interview which had appeared. I thought it was done pretty well. I did not think I had been misrepresented. The reporters did not put the things just as I would, but if they had been put that way nobody would have read them. I find the press reasonable and accurate.

If you want examples of gross inaccuracies, I can refer you to articles written by scientific men and published at leisure in scientific journals. There are plenty of such, which won't average any more accurate for their audience than the press averages for its audience, if you have the right criteria with respect to the audience.

I would like to say one word about this question of the social sciences, if there is time. The difficulty with the social sciences is, as I see it, that we are too far removed from sound scientific criteria to make it at all safe to give out as scientific knowledge anything in these fields. There are many more qualifications needed, and what is more troublesome is that there are so many factors involved as to make it difficult to give the qualifications, or to have them heeded if given.

Even relative accuracy within any proper meaning of those words can hardly be defined in the social field, and although I sympathize entirely with what Mr. Scripps has said as to what we should like to do, I do not think we are able to do it without getting ourselves into a good deal of trouble. We have had a good many expert opinions in this field in the last three or four years, and I do not think they have stood up very well.

By Dr. C. G. ABBOT

SECRETARY OF THE SMITHSONIAN INSTITUTION

I HAVE been impressed very favorably with the phonograph records which have been gotten out lately. I have loaned those which were sent me to gentlemen very active in educational affairs, and they have been exceedingly interested in them. It occurs to me that what is news to the scientists and the world which keeps up with the last final thing need not concern us altogether. There is a new generation being born all the time, and they have no means of knowing a great many interesting things that were found out a long time ago. In these records the eminent gentlemen who make them oftentimes call attention to older things which are very well worth knowing, and which, I presume, people in general do not know anything about.

I have been very much interested in recent times to read the lives of certain of those pioneers of science, industry and engineering, who lived in the last part of the nineteenth century and the early part of the twentieth century, like Eastman, Carnegie and others. Inspiring talks could come from such subjects. There has been a great deal done in science in the last one hundred years that the new generation, I presume, knows very little about. My contact with young people leads me to believe that a great deal might be done by the method of those records, which are being gotten out now by Science Service, to give a fair and reasonable basis in the minds of the young as to things which some of us know very well, if they fall within our own specialty. Yet even some of us, who regard ourselves as research men, do not know about these admitted results in other branches of service with which we have not had close connection. I feel very strongly that this record business is highly promising and perhaps will be a very useful thing to promote the objects of Science Service. These, as I understand them, are to give the public an intelligent, well-rounded, correct and useful view of science as it is. I feel that it is not so much the newest speculations, and partly verified observations, as the results most surely believed among us, that the public needs most to know.

By Dr. W. F. G. SWANN

DIRECTOR OF THE BARTOL RESEARCH FOUNDATION OF THE FRANKLIN INSTITUTE

I WAS very much interested in Professor Wilson's remarks, particularly those concerning the ultimate effect on the reader. I think the account of a subject which is given should be such as to produce the maximum of accuracy of information, in the mind of one who subsequently reads the account, and it should not necessarily aim at a maximum accuracy expression in the absolute sense. I think that in weighing the difficulties arising between the investigator's account of his work and the press account, both parties are somewhat at fault, although I must say that my experience with the press, particularly during the last few years, has been such as to make

me feel very grateful for the effort they make in the reporting of rather difficult matters.

If we trace the whole history of the subject, from the mind of the man who is working on it through his writings to the mind of the person who reads it, I think that, as a rule, the last lap of that journey is better seen by the professional press man than by the man himself who does the work.

There are two types of difficulty which arise. The investigator himself frequently starts with the feeling that his subject is a very difficult one. He does not see how it is possible to put it to the laymen at all, and endeavors to give a technical account of it, or a terribly simplified and forced analogy, to the great confusion of the reader. One of the best illustrations of this is to be found in the many discussions upon the theory of relativity. The things which we start to emphasize are four-dimensional space, curved space, and things of that kind which are not really related to the fundamental concepts which make the theory work. As regards its working content, the theory does not involve any of those things in the sense in which the reader would understand them. When the writer uses the word "space" the reader tries to get a picture of something which he thinks is in the mind of the writer and which is really not there at all. The harder he tries, the more he will get from the view which the writer intended to convey.

Then another thing: sometimes the writer, I think, is at fault in this matter by endowing the reader with too little intelligence. Thus referring again to relativity, it is impossible for the man in the street to understand what I might call the technique of the procedure, just as it is impossible for the man in the street to play the violin, although it is possible for him to get pleasure from the performance.

The thing of importance is to seek out the part of a theory which really matters and try to explain that to the reader. I believe that frequently this is possible. Personally, I would very much rather talk to an intelligent lawyer or clergyman upon the theory of relativity than I would to talk on this subject to a bad physicist. In my conversations with such individuals there would not be a single line of algebra. Turning to the press man, my criticism would be to the effect that I think there is a danger of his emphasizing matters which are irrelevant.

I think one should seek what there is of value to be said, and try to make that the central story, and not try to adorn the story with some things which are irrelevant simply because they are spectacular. There may be a certain piece of apparatus that we wish to write a story about. It may be very heavy, but the weight may have nothing to do with its performance. It is useless to try to introduce the weight as an essential feature. Let us omit all irrelevant adornment from the main subject which it is desired to discuss.

(To be concluded)

THE NEW HARVARD BIOLOGICAL LABORATORIES

By Professor G. H. PARKER

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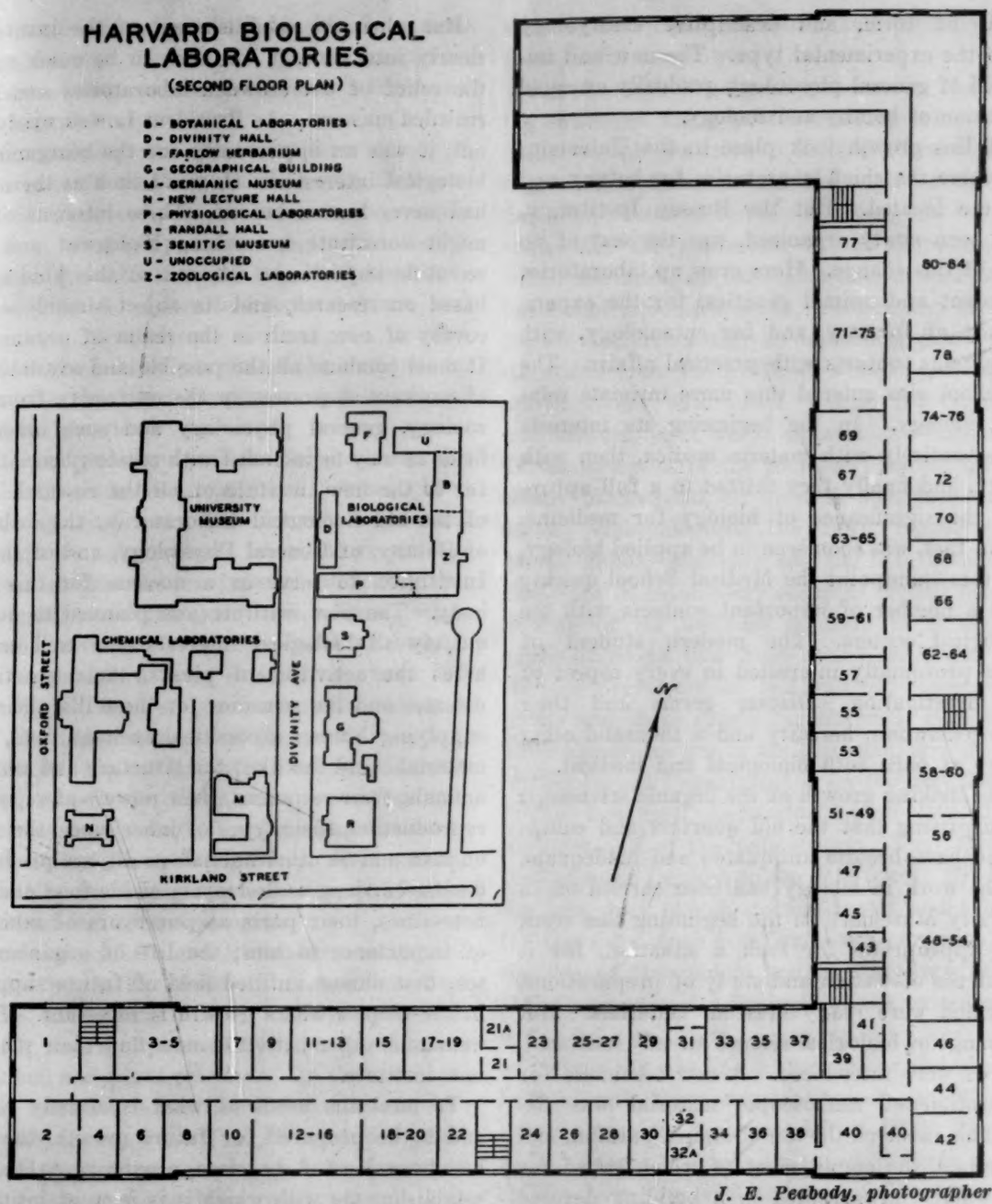
BOTANY and zoology in the last hundred years have undergone as profound a change as their sister sciences, physics and chemistry. Early in this period, workers in the organic fields were occupied chiefly with the description of plant and of animal species. At that time the study of organic processes attracted relatively little attention. But with the advent of the theory of evolution, and particularly after the appearance of Darwin's "Origin of Species," an intense interest sprang up in the operation of organic nature, and the earlier kinds of work were supplemented by a study of the activities of organisms. Reproduction and development, and a multitude of other processes, were the subjects of keen investigation. In the solution of problems in these new fields the methods of physics and of chemistry, with their accompanying mathematics, became a part of biological procedure, and attempts were made to elucidate organic operations in terms of basal conceptions. As a result, biology became permeated with the experimental spirit. The physiology of the medical schools had already taken this step and the biological sciences were quick to follow. Thus arose the functional approach to biological questions, an approach which eventually led to the fields of comparative and of general physiology. All this new expansion, with its increased scientific contacts, enriched and unified the biological sciences as had never happened before.

In the early days at Harvard, as elsewhere, botany and zoology were essentially unconnected subjects. There seemed to be no particular reason why those who were concerned with the description of new species of plants should carry on their work under the same roof as that which sheltered the describers of animal species. The activities at the Herbarium were in no intimate way associated with those at the Zoological Museum. These two institutions were separated by a considerable distance, and their work



J. E. Peabody, photographer

FIG. 1. Court Yard of the Biological Laboratories with the central section and main entrance to the right and the north wing to the left.

was carried out quite independently. A third biological center in the Harvard group was the Bussey Institution. As originally founded, it was concerned with agricultural problems, and in location, as well as in interest, it was remote from the botanical and zoological establishments in Cambridge. Its objectives being such as they were, it required the services of botanists, zoologists and chemists, and from this standpoint it became an unusual scientific meeting-place for its day. In a way the staff of the Bussey Institution foreshadowed a modern grouping. Thus the older Harvard contained several centers of first biological importance, but these centers were unconnected and scattered.

With the opening of the new Natural History Laboratories at the Museum of Comparative Zoology in the early eighties, botany, zoology and geology came into intimate relations. Workers formerly quite isolated were thrown together. With the introduction of physiological botany and the growth of the zoological sciences in experimental directions, a new atmosphere began to pervade the workrooms. The life histories of many of the lower plants and animals were investigated and their relations to food, to water supplies, and the like, were worked out, the reactions of organisms to their environment as seen in tropisms and in other types of response were studied, and the nature of inheritance, Mendelian and otherwise, began to excite the interest of investigators. Static morphology gave way to the experimental study of

the genesis of form, and descriptive embryology changed to the experimental type. The new and important field of general physiology gradually emerged from the union of botany and zoology.

Much of this growth took place in the University Museum, where the chief laboratories for botany and zoology were located. But the Bussey Institution, which had been newly organized, was the seat of no small part of this change. Here grew up laboratories for both plant and animal genetics, for the experimental study of forestry, and for entomology, with its multitudinous contacts with practical affairs. The Medical School also entered into more intimate relations with biology. In the beginning its interests were almost entirely with materia medica, then with bacteriology, and finally they shifted to a full appreciation of the significance of biology for medicine. Medicine, in fact, was soon seen to be applied biology, and from this standpoint the Medical School quickly established a number of important contacts with the other biological centers. The modern student of medicine is profoundly interested in every aspect of biological investigation. Disease germs and their carriers, regeneration, heredity and a thousand other subjects are at once both biological and medical.

With this striking growth of the organic sciences it was not surprising that the old quarters and equipment should have become antiquated and inadequate. Much of the work in biology had been carried on in the University Museum. In the beginning this work was quite appropriate for such a situation, for it consisted of the dissection and study of preparations, most of which were really museum materials. But with the change of biological science already indicated, new methods were introduced. A new technique for the preparation of microscopic material was developed. This involved the use of stains, paraffin, and other materials, the employment of which called for fire risks wholly unwarranted in a building devoted to the preservation of priceless collections, records and books. With the introduction of experimental methods came the additional risks of chemical and physical manipulation, no part of which should have been allowed in a building whose chief aim was conservation. It therefore became imperative that new quarters for the growing biological work should be sought. Moreover, the expanding activities of the museum itself were seriously crippled by lack of space, a lack which might in part have been made good by relinquishing to the rightful owner, the museum, rooms occupied for biological work. Thus arose a growing need for the establishment of the new Institute of Biology. The founding of this institute was finally rendered possible through a munificent gift from the Rockefeller Foundation and the generosity of the Harvard Corporation.

But when the establishment of the institute came clearly into view, it was seen to be much more than the relief of overcrowded laboratories and an overcrowded museum. As President Lowell wisely pointed out, it was an opportunity for the reorganization of biological interests in Harvard such as the university had never known before. These interests, if united, might constitute a working biological unit of first scientific importance. A unit of this kind should be based on research, and its object should be the discovery of new truth in the realm of organic nature. It must combine all the possible and available groups of workers at present in the university from botany, zoology, general physiology and such other related fields as may be included with reason; hence the transfer to the new institute of all the research activities of the old Zoological Laboratories, the Laboratories of Botany, of General Physiology, and of the Bussey Institution to serve as a nucleus for this growing body. The new institute was planned to house adequately all biological interests now well established here: the activities of plants, their genetics, their diseases and the remedies for these ills, their rôles in supplying human necessities, such as food, building materials, and the like; the structure and activities of animals, their responses, their powers of repair and of reproduction, their types of inheritance, their assaults on man and on other animals as disease-producers and disease-carriers, as destroyers of his food and of other necessities, their parts as purveyors of much that is of importance to him; the life of organisms in the sea, that almost untilled field of future supplies, and in the tropics where growth is incessant. These and numerous other activities now find their place in the new institute.

To meet the needs of what is already established and to be prepared for future growth, the institute has been located in close proximity to those other establishments with which it is in most intimate relations. The building has been placed on Divinity Avenue, directly opposite the University Museum, whose library, collections and staff are of vital importance to it. It is almost equally near the new chemical laboratories and only a little farther removed from the newly enlarged plant for the physical sciences. Thus the Institute of Biology is not only an unusual unit in itself but also part of a scientific group whose mutual cooperation promises in every way the most effective kind of activity and future growth.

The building housing the Laboratories is a five-story structure of red brick in modernized Georgian style. It surrounds three sides of an open court. One of its unusual features is the hand-carved frieze above the upper tier of windows on the sides forming the court yard. This carving was done directly in the face of the brick in a bold, straightforward manner

and portrays animal and plant life in its abundance. It was designed by the talented young sculptress, Miss Katharine Lane, and has excited the interests of artists far and wide.

Within the building are convenient laboratories of one, two, three or four units, furnished with all necessary service. Constant temperature rooms, soundproof rooms, photographic rooms, cold rooms, aquarium rooms, machine shops, etc., have been provided and equipped. Libraries, lecture rooms and seminar rooms have been conveniently located throughout; in the central portion of the structure an auditorium with the latest projection and sound devices has been provided.

The dividing partitions within the building are constructed of cinder-concrete blocks which have sound-absorbing surfaces. The floors are kalmen, linoleum or mastic. An internal telephone system has been installed and an elaborate system of ventilation, insuring a continuous change of air. Two electric elevators are conveniently located for both outside and inside use and two large greenhouses, each 110 feet long with six separate compartments, occupy a portion of the topmost floor of the central section. The architects for the building were Coolidge, Shepley, Bulfinch and Abbott, to whose wide experience and skill much that is admirable in the construction is due. The interior furnishings, which have proved most satisfactory and complete, were supplied by the Kewaunee Manufacturing Company.

The Laboratories of General Physiology occupy the basement and upper five floors of the western two thirds in the south wing. They are equipped with modern outfit and are planned for the quantitative study of animal and plant reactions. In the sub-basement of this section is a ventilated constant-temperature room with a range from 0° to 40° C. and capable of being held to within one degree. A system of soundproof rooms has also been constructed in this portion of the building. The basement contains several shops for working wood and metal and a triple-unit physical exercise room with connecting cold room, research rooms and shower baths. On the first floor are located most of the laboratories for class instruction. On the second floor are the offices of the department and of the chairman, library and librarian's room and research laboratories for the study of behavior. The third floor is given over to research rooms, of one, two or three units in size and planned especially for biophysical research. The fourth floor is arranged for chemical work, sensory physiology and the physiology of reproduction. On the fifth floor are rooms for the housing of small mammals such as rats, mice, guinea pigs, and the like. The planning of the section for General Physiology has been made with a view to reasonable flexibility and possible readjustment in future growth.

The Zoological Laboratories occupy the whole of the southeast angle of the building with rooms adjacent on the one hand to General Physiology and on the other to Botany. At the angle of the building from the basement to the fifth story are six suites of rooms for the professors of the department. The suites are more or less alike and consist each of a technician's room, a study, a laboratory with an attached dark-room and an aquarium room. In both directions from the professor's rooms are student research rooms with other rooms for storage, low temperature, light work, aquaria and class meetings. In the basement of the zoological section the work is chiefly biochemical, on the first floor histological, the second embryological, the third regeneration, the fourth animal reactions and the fifth oceanographic. The work in entomology occupies several floors in the portion of the building adjacent to Botany, where suites of rooms like those in the angle are set aside for the professors of this subject. Special animal rooms and store rooms for reagents, glass-ware and other apparatus are in the basement, and the office of the Zoological Department is on the first floor.

The Botanical Laboratories are housed in the northern half of the main section. They extend from the basement through to the fifth floor. The basement contains work shops, storage rooms and cold rooms. On the third floor is a large seminar room, and on the top of the middle section the large greenhouse already mentioned. The rest of the botanical section is for the most part broken up into research rooms of convenient size and grouping for the several professors with their assistants and students. These rooms house the Laboratories of Plant Morphology and Cytology, in which botanical research is pursued chiefly from the evolutionary standpoint and particularly from that of the formation of new species. Here also are to be found the Laboratories of Forest Pathology, in which are investigated fungi parasitic on forest and ornamental trees. The Laboratories of Cryptogamic Botany are located in this section where, in addition to the ferns, mosses, algae and lichens, study is made of that wide range of economically important plants, the fungi, whose relations to plant diseases and to human pathology are of the greatest significance.

The establishment of the new Biological Laboratories has thus brought about a unification of biological interest seldom seen elsewhere. With the close proximity of these laboratories to the new Harvard Chemical Laboratories, the new Geographical Building, the Laboratories of Physics and the University

Museum they enjoy an association of interest that can not help but be of the greatest importance in biological research. For these great advantages the departments thus newly housed are deeply indebted to the generosity of the Rockefeller Foundation and to the Harvard Corporation.

OBITUARY

IRWIN GILLESPIE PRIEST

IRWIN G. PRIEST, chief of the colorimetry section of the National Bureau of Standards, and internationally known as an authority on colorimetry and spectro-photometry, was taken suddenly ill on July 19, while working in his laboratory at the bureau and lived only a few hours afterwards.

Born on a farm near Loudonville, Ohio, on January 26, 1886, he had the misfortune while still a lad to lose his father. Contrary to the advice of relatives and friends, his mother courageously decided to invest her limited funds in her son's education—a sacrifice richly rewarded by his success and by a lifelong filial devotion—and young Priest entered the Ohio State University. Immediately after graduating in 1907 he came to the Bureau of Standards as Dr. Stratton's personal assistant. Thus began his work in optics, to which he applied himself henceforth with zealous enthusiasm. In scanning his fruitful research of a quarter century, one finds no evidence that he ever departed from this field.

In 1913 Mr. Priest was made chief of the colorimetry section, and from that time on he gave his attention largely to fundamental colorimetric problems. He was one of the first to recognize the importance of the spectro-photometer in colorimetric analysis and other lines of research and testing, and he contributed many ideas to the development of various types of spectrophotometric equipment. Much of the theory of interpreting spectrophotometric data in terms of dominant wave-length, purity and brightness is due to Mr. Priest, and his apparatus for the determination of color directly in these terms provided the first adequate means for testing the validity of such interpretation. This instrument, together with other apparatus which he designed, also yielded the first fundamental information regarding the sensibility of the human eye to wave-length change and purity change for nearly white colors.

He regarded the rotary-dispersion colorimetric photometer as his most important personal contribution to apparatus for color measurements. This instrument is admirably adapted not only to the determination of the color temperature and intensity of various incandescent illuminants, but is suitable also for the evaluation of these qualities for the various phases of daylight, such as sunlight, overcast sky and blue sky. His work on the standardization of Lovibond glasses has been of great practical value to the edible oil and mineral oil industries.

Mr. Priest married Miss Edna Ryan, of Washington, D. C., in 1917 and the location of their home, on the border of a wooded valley in sight of his laboratory, symbolized his devotion to his work. To this he gave himself unsparingly. He abhorred slovenliness in scientific work, and the results of his own investigation were published only after numerous repetitions of his measurements, accompanied by the most exacting attention to details.

He was fond of swimming, canoeing, walking and the woods. In his earlier years he gave generously of his time to a large and enthusiastic Boy Scout troop. His instinctive kindliness and keen sense of humor, characterized by a smile which illumined his whole face, endeared him alike to young and old.

Mr. Priest was a fellow of the American Physical Society and the American Association for the Advancement of Science, and a member of the Optical Society of America, the American Psychological Association, the Washington Academy of Sciences and the Philosophical Society of Washington. As secretary (1921–24) and president (1928–29) of the Optical Society of America he was instrumental in bringing this organization to new heights of usefulness and influence. He was a special representative of the Department of Commerce at the International Congress on Illumination held in England last year.

Though his life was short, it was extraordinarily fruitful. His name has been written indelibly upon the pages of the science he loved, and his memory is revered in the hearts of hosts of friends.

LYMAN J. BRIGGS

SCIENTIFIC EVENTS

THE BRITISH UNION OF CHEMICAL SOCIETIES

IN his presidential address to the fifty-first annual meeting of the Society of Chemical Industry, which was opened at University College, Nottingham, England, on July 13, Dr. G. T. Morgan took as his subject, "Ourselves and Kindred Societies," giving a review of the work of the union. Dr. Morgan said in part:

A full complement of subject groups would secure a better way of arranging sectional programs, but if the society achieved its ideal of one subject group for each important division of applied chemistry, such extension could scarcely be effected without encroaching on the territories of certain specialist societies. Would federation in that case ever become feasible? This consideration brought the president to the much-discussed question of the reunion of chemical associations. There were 16 separate societies, he said, for the professional and scientific welfare of chemists. He had made a survey of 14 of them, having a total membership of 23,600 and an income of £46,557 from subscriptions. The total membership figure had no personal significance, since it represented a stage army in which many individuals played several parts. With two exceptions these associations had as their most important function the publication of scientific literature for chemists. The salaries of the administrative staffs amounted to £16,000, and general office expenses to £10,900. The publication and distribution of scientific literature was, however, becoming so expensive that that society and the Chemical Society had come to an agreement in regard to the production of chemical abstracts. If all these 14 societies, which collectively had a surplus income of £2,800 over expenditure, would work in harmony and pool their financial resources, what a splendid position they would assume among the learned professions! It was high time to evolve a consolidated chemical organization with a comprehensive journal worthy of the British Empire.

The annual report showed a net decrease of 131 members. This was attributed mainly to the depression in industry and heavy taxation, but the number of new members exceeded that of recent years. Despite a reduction of £1,341 in expenditure the income was exceeded by £487.

Dr. R. H. Pickard was elected president, and Mr. H. Ballantyne, Mr. J. T. Dunn, Mr. E. D. Mason and Mr. J. Davidson Pratt were appointed members of the council. Next year's conference will be held at Newcastle.

DAIRY SCIENCE PUBLICATION

FOR the past fourteen years the American Dairy Science Association has sponsored the publication of the *Journal of Dairy Science*. Commencing with the January number of this year, this association has undertaken the management of its journal, having secured the services of The Science Press Printing Company, a firm specializing in scientific printing, to print and render other services for the journal.

According to a statement sent by one of the officers, it was felt by the American Dairy Science Association that it had a dual responsibility, since it is interested in the development of dairy science and in the dairy industry. The opportunity which was available to this association to assist in the promotion of new scientific findings in the industry as well as to scientific men was accepted as a responsibility to service the dairy industry to an even greater extent than in former years and it was largely for this reason that the association has assumed a larger part in the management of its journal.

The *Journal of Dairy Science* is the only journal published in this country devoted exclusively to dairy science. Articles are accepted for publication almost wholly on the basis of containing new facts and new discoveries in dairy science or the application of science to the industry. The data from which the author draws his conclusions are given in sufficient detail to permit the reader to study them if he so desires. No endeavor is made to popularize the results of these investigations, since this activity is so well cared for by several dairy trade journals.

A recent number of the journal illustrates the type of material which it publishes. There is an article on the uniformity of the lactose and chloride content of milk from the view-point of their influence upon flavor. Two articles are concerned with bacteriology, the one being on the effectiveness of pasteurization in destroying the organisms which cause undulant fever and the other being concerned with a method of sterilizing acidophilus milk. There are two articles on the food value of dairy products, the one being on the vitamin content of milk throughout the year and the other dealing with the digestibility of the proteins in dried milk. There are two articles on the corrosion of metals used in plant equipment by milk. One article is concerned with the body and texture of processed cheese. The amount of material dealing with the feeding and management of dairy cattle is rather meager in this number, since there is but one article dealing with alfalfa as a principal or sole diet for dairy cows. In considering these articles it should be remembered that they are not popular discussions on these subjects, but deal entirely with data experimentally secured by the various authors.

Under the new arrangement the journal is managed by a committee, of which O. F. Hunziker, Blue Valley Creamery Company, Chicago, is chairman. The journal is edited by A. C. Dahlberg, New York Agricultural Experiment Station, Geneva, N. Y., and a group of associate editors who are specialists in various phases of dairy science.

THE PLACEMENT BUREAU OF THE FEDERATION OF BIOLOGICAL SOCIETIES

THE placement bureau of the Federation of Biological Societies, which was organized some ten or twelve years ago, following a suggestion by the late Dr. S. J. Meltzer, has since 1924 been under the direction of Dr. C. W. Edmunds, of the Department of Pharmacology of the University of Michigan. The

following statement of the number of individuals who have made application to the bureau for positions and the number of laboratories and other institutions which have applied for men forms an interesting comment upon the activities of this bureau and of the service which it is rendering to the departments of physiology, biochemistry, pharmacology and pathology in the country. The figures which are given for the years between 1924 and the present time indicate a steady growth in the services of this organization. As will be seen by consulting the tables, there was a steady growth until the year 1929.

Academic year	Positions open	Positions wanted
1924–25	14	17
1925–26	23	29
1926–27	18	14
1927–28	40	41
1928–29	47	48
1929–30	70	90
1930–31	43	151
1931–32	20	150

The sharp rise in 1929 was due to increased publicity secured by placing cards in the programs which were sent to all members of the federation. Again in 1930 there was quite a marked increase in the number of applicants, due to the wider publicity given its activities.

For the past two years this number has been practically uniform, about 150 men and women who desire positions or changes of location having written in. On the other hand, the institutional demand has dropped off, due, of course, to the curtailment of institutional and laboratory activities owing to the necessity for retrenchment in expenses.

At the meeting of the federation, which was held in Philadelphia, Dr. H. B. Lewis, of the University of Michigan Department of Physiological Chemistry, was elected to succeed Dr. Edmunds in the directorship of this bureau, and he has now assumed the work so that future applications should be sent to him instead of to Dr. Edmunds.

APPROPRIATIONS FOR GRANTS-IN-AID BY THE NATIONAL RESEARCH COUNCIL

AT its June meeting, the National Research Council's Committee on Grants-in-Aid made thirty-four grants for the support of individual research, as follows, from sixty-four applications received:

J. S. Foster, professor of physics, McGill University, observations on the flash spectrum of the total solar eclipse, August 31, 1932, and investigations of the Stark effect; Curtis R. Haupt, instructor in physics, Pomona College, the probability law for electron impact in mercury vapor; Harold Osterberg, research assistant in physics, University of Wisconsin, the elastic vibrations of crystal plates; Joel Stebbins, director, Washburn Observatory, University of Wisconsin, the amplification of photoelectric currents with the thermionic tube; Karl S. Van Dyke, professor of physics, Wesleyan University, the piezo-electric effect.

Richard H. Frazier, assistant professor of electrical engineering, Massachusetts Institute of Technology, the precise determination of the specific heats of various metals; Gleason W. Kenrick, assistant professor of electrical engineering, Tufts College, statistical studies of field intensities in the low frequency region of the radio spectrum.

John G. Aston, assistant professor of chemistry, Pennsylvania State College, the heat capacities of simple organic nitrogen compounds; W. L. Beuschlein, professor of chemical engineering, University of Washington, the hydrogenation of coal in various dispersion media; Barnett F. Dodge, associate professor of chemical engineering, Yale University, the solubility of gases in liquids at high pressures, and equilibria in organic chemical reactions at high pressures; E. C. Gilbert, professor of chemistry, Oregon State Agricultural College, the thermochemistry of hydrazine and its compounds; Robert Taft, associate professor of physical chemistry, University of Kansas, the micro-structure of metals.

Edward W. Berry, professor of paleontology, the Johns Hopkins University, the fossil plants of Wankie, Rhodesia; Walter H. Bucher, professor of historical geology, University of Cincinnati, completion of the geological mapping of the Wells Creek Basin in Tennessee; Marius R. Campbell, principal geologist, U. S. Geological Survey, evidence of rock folds due to lateral pressure in the North Atlantic Coastal Plain; C. H. Crickmay, assistant professor of geology, University of Illinois, the geologic structure and stratigraphy of Mt. Jura, California; Paul H. Dunn, fellow in geology, University of Chicago, the correlation of Silurian strata in the Mississippi Valley; John B. Leighly, assistant professor of geography, University of California, meteorologic observations in the Marquesas Islands; Evans B. Mayo, instructor in mineralogy and petrography, Cornell University, the regional geology of the area of the eastern slope of the Sierra Nevada, south of Mono Lake, California; B. E. Warren, professor of physics, Massachusetts Institute of Technology, determination of the structure of feldspars by means of x-rays; Alfred O. Woodford, professor of geology, Pomona College, the characteristic longitudinal profile of water courses.

Clarence A. Mills, professor of experimental medicine, University of Cincinnati, temperature adaptation in animals; Robert A. Moore, instructor in pathology, Western Reserve University, the relation of disease of the prostate gland to senescence; Charles W. Turner, associate professor of dairy husbandry, University of Missouri, the hormones stimulating the growth and physiological activity of the mammary gland.

Henry Borsook, assistant professor of biochemistry, California Institute of Technology, the heat of combustion of organic compounds of physiological importance; Charles Chupp, professor of plant pathology, Cornell

University, the taxonomy and relationships of the fungus genus, *Cercospora;* L. R. Cleveland, assistant professor of protozoology, Harvard University Medical School, the protozoa of termites and roaches from Java and Ceylon; Margaret C. Ferguson, research professor of Botany, Wellesley College, a cytological and genetical study of *Petunia;* J. Douglas Hood, professor of biology, University of Rochester, the Thysanoptera of Trinidad and of Northeastern America.

Frances Densmore, collaborator, Bureau of American Ethnology, Smithsonian Institution, tribal songs of Indians of the Gulf States; Melvin R. Gilmore, curator of ethnology, Museum of Anthropology, University of Michigan, the ethnological significance of botanical specimens from the Indian Pueblos of the Rio Grande Valley, New Mexico.

J. E. Evans, professor of psychology, Iowa State College, the relation between the reaction time and skill of automobile drivers; John A. McGoech, professor of psychology, University of Missouri, the relation between retroactive and reproductive inhibition.

Applications to be considered at the next meeting of the Committee on Grants-in-Aid must be filed with the committee before October 15, 1932.

W. H. HOWELL,
Chairman, National Research Council

SCIENTIFIC NOTES AND NEWS

SIR JOSEPH LARMOR will retire from the Lucasian professorship of mathematics in the University of Cambridge on September 30. He will be succeeded by Dr. Paul Adrien Maurice Dirac, fellow of St. John's College.

PROFESSOR E. F. BURTON, of the department of physics at the University of Toronto, has been appointed head of the department and director of the McLennan Physics Laboratory, to succeed Professor J. C. McLennan, who retired on June 30.

THE University of Oxford conferred the honorary degree of D.C.L. on Lord Moynihan on the occasion of the delivery of the Romanes Lecture. The subject of the lecture was "The Advance of Medicine."

SIR GEORGE NEWMAN will deliver the Harveian Oration of the Royal College of Physicians, London, on October 18.

DR. MAX PLANCK, professor emeritus of theoretical physics at the University of Berlin, received recently a Goethe Medal from the German Government.

DR. CARL E. CORRENS, director of the Kaiser Wilhelm Institute for Biology, has been awarded the Harnack Medal of the Kaiser Wilhelm Association.

THE Bisset Hawkins Gold Medal of the Royal College of Physicians, London, has been awarded to Dr. T. H. C. Stevenson, for work when superintendent of statistics in the office of the Registrar General.

SIR HENRY S. WELLCOME recently visited for the first time the new buildings of his alma mater, the Philadelphia College of Pharmacy and Science. Preceding a luncheon given in his honor, Sir Henry placed a wreath on the grave of Dr. W. W. Keen. In the afternoon, at the college, he was presented with a facsimile reproduction of his graduation thesis and replicas of the molds and models that accompanied it. He plans to place these in the London museum which he founded.

THE American Society of Clinical Pathologists has elected to honorary membership Charles Achard, professor of clinical medicine in the Faculty of Medicine, member of the Institute and the Academy of Medicine, Paris; Charles F. Craig, Colonel U. S. Army, Retired, director of the department of tropical medicine, Tulane University, and Dr. E. C. Dodds, Courtauld professor of biochemistry in the University of London and chemical pathologist to the Middlesex Hospital.

AT the annual meeting of the American Society for Testing Materials the following officers were elected: Mr. Cloyd M. Chapman, consulting engineer, as president (1932–1933); Mr. William H. Bassett, metallurgical manager of the American Brass Company, as vice-president (1932–1934), and the following as members of the executive committee (1932–1934); Messrs. H. A. Gardner, J. O. Leech, J. T. MacKenzie, J. C. Ramage and H. S. Vassar.

ON the occasion of the retirement of Alvin Frank Linn from the chair of chemistry at Wittenberg College, a luncheon was given in his honor by the faculty at which a tribute was presented to him transcribed on a plaque in the style and manner of the medieval illuminators.

DR. D. H. MENZEL, assistant astronomer at the Lick Observatory of the University of California, has been appointed assistant professor of astrophysics at Harvard University.

DR. C. D. LEAKE, professor of pharmacology at the University of California, has been given the additional title of librarian of the State Medical Library.

DR. A. A. SCHAEFFER has been appointed chairman of the department of biology in Temple University.

PROFESSOR GIUNIO SALVI, who holds the chair of normal human anatomy, has been chosen rector of the University of Naples.

C. A. ADAMS, professor of engineering at the Engineering School of Harvard University, has been elected director of the American Bureau of Welding.

PROFESSOR WILLIAM BULLOCH has been elected chairman of the governing body of the Lister Institute of Preventive Medicine in succession to the late Sir David Bruce.

SIR ARTHUR KEITH has been appointed by the Royal College of Surgeons master of the Buckston Browne Research Farm.

BY an order of the committee of the British Privy Council, made after consultation with the Medical Research Council and with the president of the Royal Society, Professor A. E. Boycott, Graham professor of pathology at University College Hospital, London, and Professor E. D. Adrian, Foulerton professor of the Royal Society and fellow of Trinity College, Cambridge, are appointed members of the Medical Research Council in succession to Professor Robert Muir and Sir John H. Parsons, who retire in rotation on September 30 after four years' service.

DR. PAUL R. NEEDHAM, in association with the U. S. Bureau of Fisheries, is conducting a government survey of fish conditions in California this summer. The object of the survey is the restoration of original game conditions in the streams.

DR. N. GIST GEE, who has spent the last thirty-one years in China in scientific work, first with Soochow University and later with the Rockefeller Foundation, is leaving China and returning to the United States. Yenching University has invited him to act as its representative in the United States and he will take over that position, beginning on September 1.

SIR CHARLES SHERRINGTON will deliver the presidential address at the ninth annual conference of the Association of Special Libraries and Information Bureaus, which will be held at Oxford from September 23 to 26.

THE American Society of Agricultural Engineers will hold its annual meeting in 1934 at Asilomar, California.

THE seventeenth annual meeting of the Optical Society of America will be held at Lake Placid Club, Essex County, New York, from October 13 to 15. The club has made a special rate of $7.00 per day (meals included) to members of the society and its guests. In addition to the usual program of papers contributed by members on their own initiative, the meeting will include the following special features: An evening lecture on "The Early History of Optics" and a session devoted to invited papers on "A Century of Optics," including "The Era of Young and Fresnel" and "The Electromagnetic Theory and The Modern Theory of Light." There will be, as usual, group conferences on selected fields of optics. The annual dinner will be given at the club.

THE ninety-second meeting of the German Association of Men of Science and Physicians will take place at Wiesbaden and Mainz from September 25 to 29. Applications for membership should be made to Professor B. Rassow, Gustav-Adolf-Str. 12, Leipzig, C1.

THE three hundredth anniversary of the birthday of Spinoza will be commemorated by a philosophical congress to be held at The Hague under the auspices of Societas Spinozana from September 5 to 10. In addition to a study of Spinoza's philosophy in the historical and critical problems, there will be symposia on physics and metaphysics, religion and philosophy in the light of modern thought and on the teaching of Spinoza.

BY the will of the late George F. Kunz Columbia University receives $1,500 for a fund to be used to purchase mineralogical specimens and "common minerals" for the free use of students in the mineralogical department. The New York Mineralogical Club receives Dr. Kunz's collection of minerals with a request that it remain permanently at the American Museum of Natural History where it now is. Bequests of $1,000 each were left to the New York Academy of Sciences, for a prize fund for research in mineralogy or geology, "preferably with respect to the study of the region within fifty miles of New York City; to the American Scenic and Historic Preservation Society; to the New York Mineralogical Club of the American Museum of Natural History which was founded by the testator, the fund to be used for scientific work or for picture specimens found in this region; to the Mineralogical Society of America, and to the U. S. Geological Survey, Washington, D. C., the income to be applied to the general publication fund of that society."

THE Boyce Thompson Institute for Plant Research in Yonkers has recently made the New York Botanical Garden an important gift of about 3,400 trees and shrubs, representing about 1,500 species and varieties. This large accession, with one from the Department of Parks of Rochester, has necessitated the provision of additional nursery space. A temporary nursery has been established in the area near Bronx Park East. This has been enclosed by a fence and a water-supply has been installed.

A PRIVATE observatory containing valuable astronomical instruments, including a telescope with a 23-in. reflector, has been offered to the University of

Leeds. The observatory was erected by Mr. Scriven Bolton, a well-known amateur astronomer who died in 1929. The telescope is clock-driven and is believed to be the largest private telescope in the country, and the third largest instrument of its kind in Great Britain.

SIR AUSTEN CHAMBERLAIN has received an offer from the chairman and directors of the Prudential Assurance Company to contribute £1,500 a year for a term of seven years to the funds of the London School of Hygiene and Tropical Medicine, of whose Court of Governors Sir Austen is chairman. The directors of the company are impressed by the importance of the teaching and research in all branches of preventive medicine in which the London School is engaged, and have suggested that the contribution shall be directly associated for the duration of the gift with the university chair of public health, held by the dean of the school as head of the Division of Public Health and Industrial Hygiene.

AN exhibit of testing apparatus and related equipment by the American Society for Testing Materials will be held at the Hotel Stevens in Chicago in 1933, in conjunction with the annual meeting of the society, during the week beginning June 26. Chief among the factors leading to this decision is reported to be the favorable reception accorded the first exhibit held in 1931, together with the fact that an exhibit will attract a large number of engineers who will be attending the various engineering society meetings being held during the week of the exhibit.

THE Fourteenth Exposition of Chemical Industries, according to *Industrial and Engineering Chemistry*, will be held in New York during the week of February 27 to March 4, 1933. The Grand Central Palace will again be the location and three entire floors will be devoted to the exhibits, showing the newest developments in raw materials, machinery and manufactured products. More than one hundred and seventy-nine companies have already reserved space. The exhibitors represent over forty American industries which are classified as chemical. Special groupings of exhibits are being made, such as general equipment; chemicals and chemical products; plastics, molded products, lacquers, etc.; laboratory equipment and supplies; instruments of precision; containers and packaging section and materials-handling equipment; raw materials, natural resources and industrial opportunities, and educational instructional exhibits. The last exposition, which was held in 1931, reported an attendance of 103,000, with a registration of 22,000. Admission to the Fourteenth Exposition will be without charge, and by invitation, or by registration only. An unprecedented attendance is anticipated, because of the timely value of the new products and processes which will be displayed. Exhibits of these new products developed by research will corroborate the findings of a survey conducted recently by the Division of Engineering and Industrial Research of the National Research Council. This survey was made to ascertain the present status of activities of leading industrial research laboratories. Returns from three hundred and fifty companies show that one half had invested more in research in 1931 than in 1929.

A NEW substation, known as the Clemson College Truck Experiment Station, has been established under the South Carolina Experiment Station in Charleston County for experimental work with vegetables. A tract of 67 acres, located seven miles south of Charleston, has been deeded to the county for the use of the substation, and the county has appropriated $10,000 for buildings and equipment. The main office and laboratory building is nearing completion at a cost of $5,000, and a deep well water supply with pressure system is being installed at a cost of about $800. Two projects in cooperation with the U. S. Department of Agriculture are being conducted, one with the Bureau of Plant Industry on bean diseases and the other with the Bureau of Entomology on truck crop insects.

A CORRESPONDENT of the *Journal* of the American Medical Association states that since the outbreak of hostilities between Japanese and Chinese soldiers in February, the Institute of Science at Shanghai has been closed, and rumor had it that it would sooner or later be removed in the near future. Dr. Yokote, the director, and all his assistants who had come back in Japan, are reported to have gone back to Shanghai in order to reopen the institute, as peace is restored.

DISCUSSION

NOTE ON PREMATURE FLOWERING IN GRAPEFRUIT FROM X-RAYED SEEDS

IN the course of experimental work now in progress in the Research Laboratory of the General Electric Company on the effect of x-radiation in the growth of citrus fruits, two seedling plants have shown characteristics sufficiently striking, it is thought, to be worthy of a note at the present time. It is hoped later to publish the results of this investigation in full.

The seeds concerned were part of a lot of grapefruit, lemon, lime, tangerine and orange seed most kindly sent us in March, 1932, by Mr. R. G. La Rue, superintendent of cultivations at the college of Agri-

culture of the University of California. They represented stock ordinarily yielding the most uniform seedbed.

The seeds had been dried previous to shipment. Before treatment, they were soaked in distilled water for fifteen minutes, then left in a completely moisture-saturated atmosphere for twelve hours. They were then dried on filter paper and exposed at once. They were treated on March 8, and planted on March 16 in seed flats, a mixture of one third sharp sand, and two thirds peat moss being used, the seeds being covered with pure sharp sand. The first sprout was seen on April 14.

Two plants showed flower buds in the last week of May. They matured rather slowly, and were not ready to open until the sixth of June, when, though diminutive, they proved to be quite normal in form. The plants still carried the first pair of leaves intact, as is usual with citrus seedlings of this age. One plant was normal in leaf and flower coloration, and the leaves were nearly normal in form, though somewhat elongate and diminutive. The other seedling, however, was extremely deficient in chlorophyl—an effect not uncommonly observed in citrus seedlings—and the flower was imperfectly pigmented, being of a yellowish white color similar to the leaves. The stamens, however, were golden. The green plant received a two-minute exposure, the white, an eight-minute treatment under the same conditions. Both showed buds at the age of a little over a month. The root system of both plants was very deficient.

The apparatus used in the work was a water-cooled tungsten-target Coolidge tube, operated at 30 milliamperes current and 200 kilovolts. The seeds were exposed at 50 centimeters focal distance. The seedlings were propagated in the electrically heated greenhouse of the Research Laboratory.

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NECROBIOTIC RAYS

THE protective action of ultra-violet rays on the protoplasm of human red blood corpuscles and plant cells described in the author's recently published papers[1] could be explained by a synthetic action of ultra-violet rays on the products of a decomposition produced by poisons and hypotony in protoplasm. Thus, according to the well-known equivalence law of photochemical reactions one could expect ultra-violet rays to be produced in the decomposition of the principal compounds of protoplasm in the process of death.

Indeed, the production of ultra-violet rays was observed by the author in all investigated cases of cell death. It seems, however, that some of these rays have a smaller wave-length than any ultra-violet rays known at present. It would therefore seem expedient to call all the rays produced by dying cells necrobiotic rays in general.

These rays were observed by means of silver bromide, which is decomposed by them. In first experiments suspensions of unicellular organisms or pieces of multicellular organisms which have a large surface (yeast cells, Elodea leaves, flower petals, etc.) in water were mixed with potassium bromide and silver nitrate in an absolutely dark room, killed by ether, and exposed to diffuse sunlight. The suspensions in which the cells had been killed after the formation of silver bromide showed a quicker darkening than the suspension in which the cells had been killed before the formation of silver bromide.

In other experiments the cells were killed by heating, and after the addition of potassium bromide, silver nitrate and ether these suspensions always showed a slower darkening than living suspensions to which the same substances had been added. If, after the addition of the substances mentioned, the suspensions were filtered, the liquid obtained showed a pinkish color without being exposed to light if the cells were killed after the formation of silver bromide, but remained colorless if the cells were killed before this formation. The color was considerably increased after the addition of a developer.

That the rays which had decomposed the silver bromide in the above experiments have a rather short wave-length is seen from the fact that they do not affect ordinary photographic plates which had been protected from the liquid by quartz plates sealed with wax. The rays affected, however, a dilute suspension of silver bromide which had been introduced in quartz tubes closed with glass stoppers into a suspension of yeast, which was then killed by different poisons.

It is evident that ultra-violet rays can be emitted also in very energetic physiological processes which are accompanied by the decomposition of the principal compounds of living matter. It is therefore not surprising that living cells and tissues may emit them in such a very small amount that they may not be detected by silver bromide, but in an amount sufficient to produce an acceleration of certain processes in the cell, as, for instance, cell division. This is the reason why we may venture to say that the so-called mitogenetic rays are really necrobiotic rays.

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[1] W. W. Lepeschkin, SCIENCE, 73, 568, 1931; *Protoplasma*, 14, 11, 1931; *Amer. Jour. of Botany*, July issue, 1932.

PROBABILITY OF A MAGNETIC STORM DURING THE SOLAR ECLIPSE OF AUGUST 31, 1932

A NUMBER of investigators have planned radio measurements of one kind or another during the solar eclipse of August 31, 1932. Such measurements will be related to a certain extent to the magnetic character of the day. In fact the state of the ionized regions of the upper atmosphere bears about the same relation to these experiments as does the weather to those of the astronomers. It is desirable, therefore, to predict as well as possible the radio and magnetic character of the day.

On the basis of the 27 day recurrence tendency it is probable that the earth's field and radio transmission will be disturbed at least moderately and possibly severely, the maximum disturbance occurring a day or so before the eclipse. The date of the eclipse falls in a sequence of magnetic disturbances which have been active for at least three revolutions of the sun (approximately 27 day period). The latest storm of this sequence on August 1 or 2 has been of moderate intensity. A large sun-spot surrounded by bright hydrogen flocculi crossed the central meridian of the sun on August 2. On this basis a storm would be expected to begin on August 28 or 29 and might last until after the eclipse. Since the radio phenomena are different on days when magnetic storms occur from those on days without disturbance it is important that experiments to be carried out during the eclipse be planned with this possibility in mind.

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A PROPOSED WORKING ABSTRACT OF THE LITERATURE OF CHEMISTRY

WHENEVER a research is undertaken in chemistry, the first thing to be done is to find out what has been done in the past along the lines related to the research in hand. If the facts already discovered are known by the researcher, much time is saved in all research projects; in fact, it is foolish, at the present time, to undertake a piece of research work without first finding what has already been done along the line of the investigation and related lines.

This means that the investigator must have access to all the literature of chemistry, that he must devote a lot of time to searching through the literature to find what is there, and often it involves trips to other libraries and other parts of the country, or even to other countries, if the work is to be done in a thorough manner. Many times this requires weeks or months of time, and quite often it is true that some very essential things are overlooked in these searches as they are so often undertaken by those who are inefficient or inexperienced in such things.

This preliminary investigation would be far better if it could be carried out by one or several familiar with such work. At present the ordinary method is for each one attempting a piece of research work to make his own investigation of what has been done along the lines of the project in hand. But few of those who have been trying investigations know how to do this with accuracy and completeness. A beginner at research or one with small experience is sure to do it in an inefficient way at first.

It is proposed to prepare a working abstract or set of abstracts of all chemical literature. This is not to be an abstract in the ordinary sense which often only gives what articles are about and the conclusions reached. It is proposed to put the essential facts of all chemical literature on a set of cards, these cards to give the actual working or reacting things as stated in the literature, so that the real chemistry involved may appear and may be understood and used without having to go to the original articles which are scattered through the literature. It is proposed to put these facts on cards and arrange these cards as any other card index is arranged, with cross references, etc. Whenever chemical reactions are involved, these are to be given on the cards so that one would have the actual data for the re-performance of the experiments. It is proposed that this index cover the whole range of the literature of chemistry so that any one starting an investigation would have at hand all the known facts in regard to the subject under consideration. As soon as all the literature has been abstracted the complete story of chemical literature and chemical experimentation would be at this one place, although it may have been gathered from many libraries and from the literature of the world. Moreover, it will have been gathered by those who knew how to do this work and not by novices, and it is a complete story. There would be no restriction of the abstracts to journal articles, but institutional publications, special pamphlets and all other chemical literature would be included and used.

A complete abstract of the kind suggested would save hundreds of repetitions of library work, would be more complete than any new researcher could hope to make for himself on his subject, would give more material than any one library in the world could otherwise furnish and would be at hand for immediate use. One can not even make an estimate of how much this would speed up research in chemistry, but surely it would not only save time but would give the man starting a research the complete story of what has been done and give it to him at one place and prepared by those skilled in doing such work. It would also be a great incentive to new work and

new investigations, since many an investigation is not entered into because of the difficulty of learning fully what has been done. One fears to devote time and energy to something which may have been already tried out in another place or another country. The time saved by this proposed system of abstracting will permit many a good investigator to take up problems for which he does not have time under the present system. What a boon it would be to industrial chemistry!

It will take time and money to carry out this proposed plan, but it will be a mine when it is in shape—a mine furnishing real precious products. After the chemical literature of the past has been once abstracted it will not require so much expense to keep the material up to date.

The great universities of the country might combine in their efforts and carry out such a project. Many sets of the cards could be printed without great additional expense, and thus the complete work would be given to each of the institutions. In this way the expense would not be so great for each institution. Large industrial organizations might join with the institutions or they might get together and carry out the plan themselves. It would grow into a very large card system and would require space for installation and care. As the years go by, it would continue to grow and occupy more space.

Another method of carrying out such a project would be the formation of an independent organization for the purpose which would be endowed and completely fitted for carrying on the work. This organization could print numerous copies of all cards made and furnish them to educational institutions or industrial organizations wanting them—either a complete set or those on given subjects as desired. This would call for a liberal endowment.

Other methods of carrying out the plan are possible, of course, and even better ones might be found. There is no question but that the idea is a great one and the carrying out of such a plan would involve excellent planning and a considerable outlay of money. It would be one of the greatest scientific achievements of the century.

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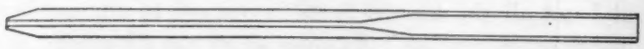
SCIENTIFIC APPARATUS AND LABORATORY METHODS

A PIPETTE FOR THE DILUTION COUNTING OF HOOKWORM EGGS[1]

THE pipette shown in the accompanying figure has, in this laboratory, proved more satisfactory than any



other suggested for use in the dilution counting of hookworm and other parasite eggs in human feces, by Stoll's method.[2] It consists of a 12 cm length of capillary glass tubing, with inside diameter between 1.0 and 1.1 mm and outside diameter approximately 7 mm, fused at one end to a piece of ordinary glass tubing, with outside diameter of 7 to 8 mm, to make a total length of 20 cm. The taper inside the junction should be perfectly smooth and even and approximately 1.5 cm in length. The end of the capillary tubing is ground on a carborundum stone or wheel and finished on a fine stone to produce a smooth, strong tip.

When one is calibrated, all others from the same stock can be estimated quite closely, thus shortening the labor of calibration. In this laboratory it has been found that technicians are most accurate in calibrating if they are instructed to vary the marking of the pipette until 20 times will fill, level full, a serum tube which has been cut off to hold exactly 1.5 ml. Final checking is then done by the person in charge, and recorded on the pipette with a diamond pencil. The resulting column of fluid will contain the required .075 ml and will vary in length from 65 to 95 mm, within which limits reading is quite accurate.

This pipette eliminates the difficulty of contamination of successive specimens by the accidental filling of the rubber bulb, a frequent occurrence in similar capillary pipettes which do not have the larger tubing attached. Furthermore, this pipette has not the fragility of those drawn from larger tubing, nor the tendency to clog found when the latter are drawn to a taper.

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[1] The studies and observations on which this paper is based were conducted under the auspices of the Department of Public Health of the Egyptian Government and the International Health Division of the Rockefeller Foundation.

[2] N. R. Stoll and W. C. Hausheer, "Two Options in Dilution Egg Counting: Small Drop and Displacement," *Amer. Jour. Hygiene*, 6: 134–145, March Supplement, 1926.

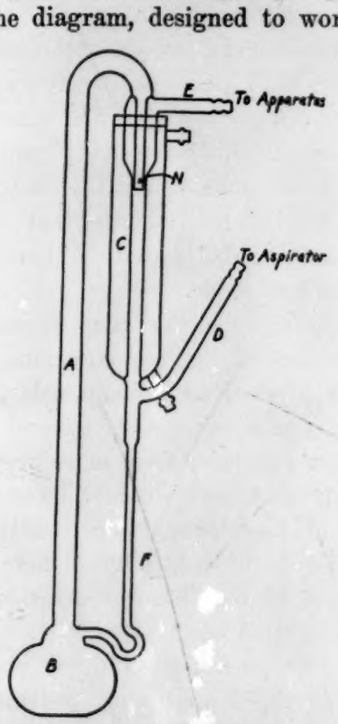
MERCURY VAPOR PUMPS FOR VACUUM DISTILLATIONS[1]

THE vacuum pumps used in organic laboratories to evacuate distilling apparatus are ordinarily of the

[1] Contributed from the Chemical Laboratory of the University of North Carolina.

Cenco Hyvac type. Vapors from organic distilling apparatus frequently and soon ruin their efficiency either by corroding the insides of the pump or by dissolving in the pump oil and making the limiting pressure of the pump equal to the vapor pressure of the oil. In the case of corrosion, the pump is ruined, and in the case of vapors dissolved in the oil, the pump must be taken apart, cleaned and have new oil put in—a very messy job. Moreover, pumps of this kind will not pump condensable vapors, because they operate as piston pumps. Another disadvantage is that they are rather expensive.

A Pyrex glass mercury vapor pump of the type shown in the diagram, designed to work against an



aspirator as a force pump has none of these disadvantages, although it has a few drawbacks of its own. It is made of glass and so is not subject to corrosion except for the mercury that it contains. It contains no oil to absorb vapors and spoil its efficiency. When it becomes dirty, it is much easier and less messy to clean, for this can be quickly done with nitric acid. Since it works by diffusion, it will pump condensable vapors. In addition, it is a much less expensive piece of apparatus than an oil pump and occupies a smaller table space.

A type of pump suitable for doing vacuum distillations is shown in the figure. The boiler B should be a flattened bulb about 6.5 cm in diameter and 4.5 cm in thickness. It is not absolutely necessary to use a flattened bulb, but this shape gives rise to less bumping of the mercury during operation of the pump than a spherical boiler. Tube A, which leads from the boiler to the nozzle N, can be made from 1.5 cm tubing. The nozzle should be 7 mm in outside diameter and project a distance of one centimeter into the narrow part of the condenser. The condenser should be 8 mm inside diameter. A 15 cm condenser will be found long enough to condense all the mercury. The return tube F should be 14 cm long. Although most of these dimensions may vary, the dimensions of the nozzle and the length of the return tube should not be changed, since they are vital to the operation of the pump.

The operation of a pump of this type is quite simple. The main requirements for its satisfactory operation are that the apparatus to be evacuated be as free as possible from leaks and that the aspirator to be used as a force pump be one capable of producing a vacuum of 30 mm of mercury or better. In use, the pump is clamped to a ringstand by means of asbestos padded clamps at a height such that a good burner can be used to heat the boiler which has about one centimeter of mercury in it. The outlet tube D is connected by means of suction tubing through a safety trap to the aspirator which is to serve as a fore pump. The inlet tube E is connected to the vacuum distilling apparatus and the condenser is connected to the water supply and to the sink. After the apparatus is connected, the aspirator is turned on. When the pressure in the apparatus gets down to 30 mm of mercury, the mercury vapor pump is started. This is done by starting the water through the condenser and lighting the burner under the boiler. The burner should be regulated so that the mercury stands about 7 cm high in the return tube F. If the condenser used with the distilling apparatus is not efficient enough to condense all the vapors of the substance being distilled, it is a good idea to insert a trap cooled with ice between the distilling apparatus and the pump.

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SPECIAL ARTICLES

THE VALIDITY OF MEASURING EYE MOVEMENTS BY DIRECT OBSERVATION

IN clinical and experimental studies of eye movements during reading one method of measurement has been to count the number of fixations through direct observation. (A mirror is sometimes used to obtain a better view of the eyes.) However, during a recent experiment this method gave results which were inconsistent with those obtained from photographing eye movements with the Iowa Eye Movement

Camera,[1] so the following experiments were carried out to determine the validity of the former technique.

Two clinicians, *M* and *R*, both of whom were experienced in counting eye movements, photographed the eye movements of 31 and 38 poor readers in college, respectively, and at the same time counted these movements through direct observation. Paragraphs about two hundred words in length taken from the Van Wagenen Reading Scales were used as reading materials. From the records thus obtained three scores were computed for each reader: (1) the number of eye movements actually made (photographed), (2) the number counted by direct observation, and (3) the time of reading the selection (from the time marker on the film). The intercorrelations of these variables for each clinician are as follows:

Tests	*M*	*R*
r of photographed and counted	.758 ± .051	.895 ± .013
r of photographed and time	.933 ± .011	.931 ± .010
r of counted and time	.811 ± .036	.928 ± .010

On the basis of the standard error of estimate[2] the above figures indicate that *M* can predict the photographed value 28 per cent. better by using time as a measure than he can by using the number counted. If *R* uses time his prediction is 7 per cent. better than if he uses the number of fixations counted through direct observation. Therefore, time, or rate of reading, is a better measure of the number of eye movements actually made than is the number counted by direct observation.

The question then arises as to whether or not the two variables, number counted and time, will give a better prediction of the number of eye movements actually made, *i.e.*, photographed number, than either variable alone. The multiple correlation of the photographed number with the number counted and time is .933 for *M* and .935 for *R*. For *M* to use both variables for prediction is no better than to use time alone and it is only 3 per cent. better for *R*. The reason for this is found in the fact that the true correlation between the number counted and the photographed number when time is held constant is .01 for *M* and .23 for *R*. This means that if all subjects had read for the same length of time, say one minute, the empirical correlation between the number counted and the photographed number would have approximated the above noted partial correlations. Just as Holzinger has pointed out that the correlation between ossification ratio and mental age is due to variation in chronological age,[3] so the zero order correlation between the number of eye movements counted by direct observation and the photographed number of eye movements is a function of variability in the time of reading the selection.

Counting eye movements is affected by many things. In this experiment, which continued through several months, each clinician found periods in which he tended to more nearly approximate the number actually made than at other times. At one period a tendency to count more than actually occurred was noted; on the average, however, the number counted represented for *M* 77 per cent. of the number photographed and for *R* 85 per cent. In other words, the clinicians in counting did not usually approximate the number of eye movements actually made. Also, the zero order correlations indicate that the number counted is more highly related to time than to the number of fixations made.

While it is to be noted that there is some variation in the correlations of the two clinicians, the significance of their predictions is comparable, so that the conclusions of this study have a general application. If good readers had been used, more accurate results would probably have been obtained because the larger excursions would have been easier to note. However, it is with the type of student used here who fixates almost every word that clinical diagnosis from eye movements is carried out.

The zero order correlations noted above indicate the validity of these measuring instruments in the actual reading situation. They show that both time and number counted are fair measures of the number of eye movements actually made. Of the two, however, time rather than the number counted gives a better prediction. Even this technique should be used only for preliminary diagnosis, though, since it gives at best a prediction of the photographed number only 64 per cent. better than chance. For an accurate picture of the nature of an individual's eye movements, photography must be used.

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[1] H. H. Jasper and R. Y. Walker, "The Iowa Eye-Movement Camera," SCIENCE, 74, 1931, 291–94.

[2] K. J. Holzinger, "Statistical Methods for Students in Education." New York: Ginn and Company, page 166.

[3] *Ibid.*, page 284.

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